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ABSTRACT

The purpose of the study was to investigate differences in learning as attributed to the instructional treatment of behavioral objectives of students in a general physical science laboratory. It was hypothesized that there would be no significant difference in the achievement of students in physical science who were exposed to laboratory methods in which they conducted experimentation without prior behavioral objectives, and those students who were presented behavioral objectives prior to experimentation. The experimental and control populations were randomly selected from 94 freshmen enrolled in the Thirteen College Curriculum Program Phsical Science Course at Norfolk State College. An analysis of the results failed to reject the hypothesis, and indicated no significant difference between presenting performance objectives and not furnishing performance objectives to the students. No significant differences in achievement were evident between the experimental and control groups with respect to sex of the subjects or major area of study (business or education). Nor was there a significant difference in terms of attitudes toward science as it was related to the sex of students when attitude were controlled by an analysis of covariance. (JR)

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A COMPARATIVE STUDY OF THE EFFECTS OF PRIOR KNOWLEDGE OF PERFORMANCE OBJECTIVES ON COGNITIVE LEARNING OUTCOMES IN THE INSTRUCTION OF TCCP PHYSICAL SCIENCE

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Introduction

The crescendo attending to the use of behavioral objectives for remedying educational ills is becoming increasingly audible. Among the arguments for using behaviorally stated objectives are (a) unless a teacher (or seahorse, Mager, 1962) knows exactly where he is going he may find himself somewhere else; (b) behaviorally stated objectives reduce wasted time in temporary diversions, ephemeral entertainment, or other irrelevancies (Popham and Baker, 1968); and (c) stating goals in behavioral terms permits a more objective measurement of goal attainment.

Presently, more verbiage than data has spilled on the assumption that with objectives stated behaviorally, instruction will be improved by decreasing the time required for learning the content of a particular subject. The logical arguments for using behavioral objectives would be enhanced with additional, supportive empirical data.

Statement of the Problem

It was the purpose of this study to investigate differences in learning as attributed to the instructional treatment of behavioral objectives of students enrolled in a general physical science laboratory.

Hypothesis

There is no significant difference in the achievement of students in physical science who are exposed to laboratory methods in which they conduct experimentation without prior behavioral objectives and those students who are presented behavioral objec-

tives prior to the experimentation. The hypothesis holds true for the following criteria.

1. Learning facts and principles of College Physical Science, as measured by the Sequential Test of Educational Progress--Form 1B (1957).

2. Attitude toward science and the process of science, as measured by the Welch Science Process Inventory--Form D (1966).

3. Understanding the knowledge and principles of TCCP Physical Science, as measured by a teacher-made achievement test (the Coleman Achievement Test) constructed by the writer.

4. Ability to think critically, as measured by the Watson-Glaser Critical Thinking Appraisal (1961).

Subproblems

1. Is there a significant difference in achievement between males in the experimental group and males in the control group, and is there a difference in achievement between females in the experimental group and females in the control group?

2. Is there a significant difference in the achievement with respect to the students' majors?

3. Are attitudes toward science related to the sex of the student when initial attitudes are controlled by an analysis of covariance?

General Experimental Procedure

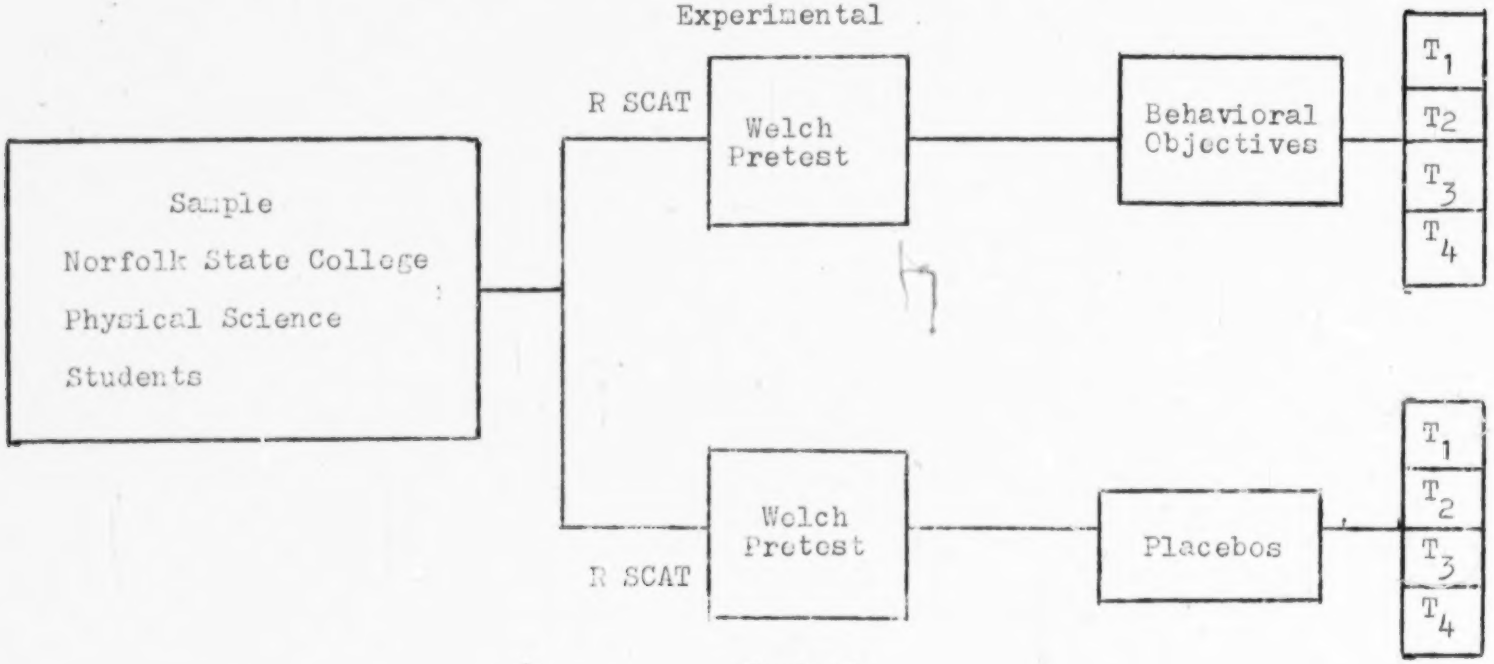
The subjects used in the study were 94 freshmen who were enrolled in the Thirteen College Curriculum Program Physical Science Course at Norfolk State College. The students were divided

into two groups by selecting a laboratory number. The decision as to which group would be the experimental or control was made by the toss of a coin. Students with odd numbers were designated as the experimental group and students selecting even numbers comprised the control group. The two groups met for the same number of hours in the same classroom each period with the difference in possession of performance objectives serving as the experimental treatment. Although the control group and the experimental group met during the same instructional period, they were unaware of the experiment due to the fact that both the performance objectives and the placebos were printed so that they appeared to be the same. The study was conducted over an interval of 12 weeks.

Experimental Design

A modification of the Pretest-Posttest Control Group Design described by D. T. Campbell and J. C. Stanley (1963) was chosen as the design for this study. According to Campbell and Stanley (1963), it is a widespread experimental design in educational research. It was selected to be used in this study because the design best suited the situation where groups could be randomly assigned to treatments.

BLOCK DIAGRAM OF EXPERIMENTAL PROCEDURE



R = Randomization

E = Experimental

C = Control

T_1 = Welch Posttest

T_2 = Achievement Test (objectives)

T_3 = STEP

T_4 = Watson-Glaser

Data Analysis

The data collected for each student from the criterion instruments were subjected to the Pearson Product Moment Correlation Coefficient Program at The Pennsylvania State University Computer Center. This program showed the correlation coefficient which existed between each of the criterion instruments employed in the study.

The Analysis of Covariance Program from The Pennsylvania State University Computer Center was used to interpret data and information pertinent to the major hypothesis and subproblem investigated in the study. Winer (1962:578) has described the analysis of covariance technique which was used as follows:

> The analysis of covariance is used to control variability due to experimental error.... It is also used to increase the precision of an experiment and remove potential sources of bias in an experiment.

The F ratio test was used to measure significant differences with the level of significance set at .05.

In addressing the major hypothesis, the following statements describe the procedures used in answering the questions posed in the research.

1. An analysis of covariance was run on STEP with SCAT as covariate.

2. An analysis of covariance was run on STEP with the Welch test as covariate.

3. An analysis of covariance was used to determine achievement with SCAT being the covariate and the teacher-made achievement test as the dependent variable.

4. An analysis of covariance was also run on Watson-Glaser with SCAT as covariate.

In addressing the subproblems, an analysis of covariance was made to determine:

1. A difference in achievement in terms of the student's sex.

2. A difference in achievement with respect to the student's major.

The students were divided into two subgroups according to their major field of study--education or business. This procedure was followed because 95 percent of the students in the population comprised these two majors. The remaining five percent were majors in social science. According to the Social Science Department at Norfolk State College, 80 percent of their degree candidates eventually assume teaching positions. Therefore, the students in the social sciences were classified under the heading of education majors.

3. A difference in attitude toward science as related to the sex of the student.

Discussion and Conclusions

The experimental results procured in investigating the major problem and the subproblems are indicative of the following conclusions concerning the relative effectiveness of prior knowledge of performance objectives on cognitive learning outcomes in the teaching of college physical science to nonscience majors:

1. Major Hypothesis

The use of performance objectives prior to instruction

appears to be equivalent to the laboratory procedure of not providing prior performance objectives. This holds true with regard to:

a) Achievement when the School and College Ability Test is controlled as a covariate.

b) Promoting critical thinking when STEP is controlled as a covariate.

2. Subproblem 1

Regardless of sex, there was no significant difference in academic achievement in science content whether or not performance objectives were utilized prior to laboratory instruction.

3. Subproblem 2

Regardless of major (business or education) there was no significant difference in academic achievement in science content whether or not performance objectives were provided prior to laboratory instruction.

4. Subproblem 3

The presence or absence of performance objectives prior to laboratory instruction does not appear to produce a significant difference in terms of attitudes toward science as it is related to the sex of students when attitudes are controlled by an analysis of covariance.

The finding of this rather limited study failed to reject the hypothesis that there is no significant difference between presenting performance objectives and not furnishing performance objectives to the students. It is noteworthy to mention the fact

that the findings in this investigation were contrary to the findings in similar studies by Herron (1971), Olsen (1972), Dalis (1970), Piatt (1969), and Deno and Jenkins (1969). However, this study does lend support to findings of Colon (1970), Simpson (1969), and Baker (1969). In the latter three studies the possession of behavioral objectives in advance did not enhance achievement.

It should be mentioned at this point that this study is different from other studies in the following ways: (1) Both groups were in the same class; therefore, the tendency to overemphasize certain points in favor of any particular group was minimized. (2) The use of TCCP Physical Science is quite different from most college physical science courses in that course material is organized so that each unit of study can be used as an instructional module. (3) The students' areas of matriculation were concentrated in either business or education.

This study failed to lend support to the notion that the use of performance objectives will enable students to perform specified tasks better than those students who do not receive performance objectives. Perhaps the placebos were too specific so that a difference between the experimental and the control group was not noted However, this investigator feels that the use of performance objectives should be employed in some form. In the survey question which was given during the examination period, 97 percent of the 47 students who had been given the performance objectives said that they were helpful, while only three out of the 47 students who were in the control group expressed that the objectives were helpful. This seems to suggest that the time the student spends in under-

standing the material may be reduced by the availability of performance objectives. If only five minutes were saved, the effort is worth it in terms of having more time to devote to other areas which may be nebulous to the student.

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